

## TITLE

### FOOTWEAR WITH EXPANDED THERMOPLASTIC BEADS IN THE FOOTBED

## BACKGROUND

[0001] The present invention relates to footwear such as shoes, sandals, and insoles. Due to the well known nature of these items, a detailed description of the prior art is unnecessary.

## SUMMARY OF THE INVENTION

[0002] At least one portion of the footwear (e.g., the footbed) is filled with small beads that can shift about during normal use. In some preferred embodiments, the beads are made of expanded thermoplastic such as expanded polystyrene.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0003] FIG. 1 is a top view of an embodiment of the invention, in the form of a thong sandal.

[0004] FIG. 2 is a side view of the sandal of FIG. 1.

[0005] FIG. 3 is a top view of a lower sole assembly for use in the sandal of FIG. 1.

[0006] FIG. 4A is a top view of a bag containing expanded thermoplastic beads (ETBs) for use in the sandal of FIG. 1.

[0007] FIG. 4B is a section view of the bag of FIG. 4A, taken along section line B-B in FIG. 4A.

[0008] FIG. 4C is a section view of the bag of FIG. 4A taken along section line C-C in FIG. 4A.

[0009] FIG. 5 is another top view of the sandal of FIG. 1.

[0010] FIG. 6A is a section view that shows the internal structures of a first embodiment of the sole of the FIG. 5 sandal, taken along line 6-6 in FIG. 5.

[0011] FIG. 6B is a section view that shows the internal structures of a second embodiment of the sole of the FIG. 5 sandal, taken along line 6-6 in FIG. 5.

[0012] FIG. 6C is a section view that shows the internal structures of a third embodiment of the sole of the FIG. 5 sandal, taken along line 6-6 in FIG. 5.

[0013] FIG. 6D is a section view that shows the internal structures of a fourth embodiment of the sole of the FIG. 5 sandal, taken along line 6-6 in FIG. 5.

[0014] FIG. 7 is a section view, taken along lines 7-7 in FIG. 5, showing details of the construction of the rear strap.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] FIGS. 1 and 2 are, respectively, top and side views of an embodiment of the invention in the form of a thong sandal. The illustrated sandal has a sole 12, and the sole has an upper surface 13. A rear strap 16 is connected to the sole 12 at the rear end of the rear strap. A front strap 18 connects the forward end of the rear strap 16 to the sole 12. An outsole 14 serves at the bottom layer of the sole 12 and contacts the ground during normal use.

**[0016]** FIG. 3 is a top view of a lower sole assembly 30 that is used in the first three embodiments of the sandal. From this top view, only the side wall 32 and the upper surface 34 of the lower sole assembly 30 are visible. The side walls 32 and upper surface 34 define a recess. The lower sole assembly 30 preferably comprises rubber, plastic, leather, or any other similarly strong and flexible material.

**[0017]** FIG. 4A shows a bag 40 that is preferably shaped so that it will fit into the recess described above in connection with FIG. 3. The bag 40 has a thin, flexible outer wall 42, and is filled with filling 10 (shown in FIGS. 4B and 4C). The wall 42 is preferably made of a lightweight fabric such as a stretch jersey fabric with a weight on the order of about 3.5 to 7 ounces per square yard, which provides a good degree of flexibility and strength. The bag 40 may be sealed using any conventional approach (including but not limited to sewed, glued, heat-sealed, etc.).

**[0018]** The FIG. 4A embodiment includes button holes 44 that provide a path for the straps 16, 18 to pass through the bag 40 without disturbing the bag's integrity or its ability to effectively contain the filling 10. This configuration permits the rear strap 16 and the front strap 18 to be connected to the lower sole with a strong and stable connection. FIG. 4B is a section view of the bag 40 taken along lines B-B in FIG. 4A, which passes directly through a button hole 44. FIG. 4C is a section view of the bag 40 taken along lines C-C in FIG. 4A, which does not pass through a button hole. Taken together, FIGS. 4A-4C show how the bag wall 42 remains intact despite the presence of the button holes 44, so as to enclose the filling 10 within the bag.

**[0019]** The filling 10 is preferably made of expanded thermoplastic beads (ETBs) that are roughly spherical in shape. The beads are not amalgamated together (i.e., they are not united or

combined into a unified or integrated whole, as they might be in a block of Styrofoam). Instead, the individual beads are preferably free to move about with respect to one another, within the confines of the bag 40. In one preferred embodiment, the mean diameter of the ETBs is on the order of 0.8 mm. The size distribution of the beads may be tightly centered about the mean diameter, so that most of the beads would measure between about 0.7 and 0.9 mm.

Alternatively, the size distribution may vary more widely (e.g., with the size of the beads ranging from 0.6 - 1.2 mm). In other embodiments, the average size of the beads is between about 2/3 mm and 1 mm, or even between about a 1/2 and 1.5 mm. The shape of the beads may also be varied by, for example, using beads that are roughly oblate instead of spherical.

[0020] Preferably, a sufficient quantity of beads is included to form a bed that is, on average, at least about one quarter inch thick. In some embodiments, for example, the filling will have a volume of between about 2-5 cubic inches for adult size sandals, and will contain more than 10,000 beads. The preferred packing density for the beads within the bag 40 is preferably low enough so that when a user walks on the sandal, the beads can shift around to some extent (due to the pressure from the user's foot that is transmitted through the flexible walls 42 of the bag 40), but high enough so that the user's foot is supported by a layer of beads that is at least a few beads thick.

[0021] While the most preferred material for the filling 10 is expanded polystyrene beads, other types of expanded thermoplastic beads (e.g., expanded polypropylene beads) may also be used. In less preferred embodiments, other materials that share at least some characteristics (e.g., size, shape, and resiliency) with the preferred beads may be used instead of ETBs.

**[0022]** FIG. 5 is another top view of the sandal of FIG. 1, with markings to indicate the various section views. As explained above in connection with FIGS. 1 and 2, a rear strap 16 is connected to the sole 12 at the rear end of the rear strap; and a front strap 18 connects the forward end of the rear strap 16 to the sole 12. FIGS. 6A-6D are section views, each taken along section line 6-6 in FIG. 5, of four different embodiments of the sole 12.

**[0023]** In the FIG. 6A embodiment, the sole 12 includes an outsole 14, a lower sole 36 that is affixed to the outsole, an upper sole 62, and a bag 40 filled with ETBs. The bag 40 is held in place between the lower sole 36 and the upper sole 32 (thereby indirectly retaining the ETBs between the lower sole and the upper sole). The outsole 14 may be affixed to the lower sole 36 using, for example, heat-fusing, cementing, or alternative affixing approaches that will be apparent to persons skilled in the relevant arts. In this embodiment, the lower sole 36 and the outsole 14, taken together, correspond to the lower sole assembly 30 discussed above in connection with FIG. 3. Returning now to FIG. 6A, the outsole 14 is preferably made of a flexible and relatively tough material such as leather, rubber, or EVA, or any other material that is conventionally used for outsoles. The lower sole 36 is preferably made of a flexible material such as leather, rubber, or foamed plastic, or any other material that is conventionally used for midsoles. The sidewalls 32 and the upper surface 34 of the lower sole 36 define a recess. The bag 40 rests in that recess and is shaped to match the recess. As discussed above, the bag 40 is preferably filled with ETBs.

**[0024]** The upper sole 62 is disposed on top of the bag 40 and secured to the lower sole assembly. The upper sole 62 is preferably a thin, flexible material (e.g., stretch cotton jersey fabric with a weight on the order of about 3.5 to 7 ounces per square yard). Other fabrics or materials may be substituted therefore, including but not limited to knit fabrics, woven fabrics,

and flexible leather. Such materials are preferably selected so that the upper sole can transmit force from the user's foot to the ETBs in the bag 40, such that the ETBs can shift around to some extent in response to the changes in pressure that occur during ordinary walking. The upper sole 62 is preferably secured to either the lower sole 36 or the outsole 14 (using, for example, adhesives, stitching, or any other approach that provides a relatively strong and permanent connection). Suitable attachment surfaces include the outer surface of the sidewall 32 and/or the lower surface of the lower sole 36 and/or the upper surface of the outsole 14.

**[0025]** The upper sole 62 is disposed above the bag 40 so as to keep the bag confined in the footbed between the upper sole 62 and the lower sole 36. Note that although FIG. 6A depicts a space between the upper sole 62 and the upper wall 42 of the bag 40, the flexibility of the upper sole 62 will actually cause the upper sole to rest directly on top of the upper wall 42 of the bag 40. They are depicted separately, however, for explanatory purposes.

**[0026]** Returning now to FIG. 5, the sandal also includes a rear strap 16 and a front strap 18. In embodiments where the bag 40 has button holes 44 (as shown in FIG. 4A), the straps 16, 18 may be connected directly to the lower sole assembly through the gaps in the middle of the button holes 44. Preferably, the upper sole 62 in these embodiments also includes button holes (not shown) that line up with the button holes 44 of the bag 40, so the straps can pass through both sets of button holes on their way down to the lower sole assembly. Connecting the straps 16, 18 directly to the lower sole assembly provides a relatively secure and strong mount for the straps. In these embodiments, the straps may be secured to the lower sole assembly using any of a variety of techniques that are conventionally used for sandals, which will be apparent to persons skilled in the relevant arts.

[0027] In an alternative embodiment neither the bag 40 nor the upper sole 62 has button holes, and the straps 16, 18 are attached directly to the upper sole 62 (e.g., by sewing the straps 16, 18 directly to the upper sole 62).

[0028] FIG. 6B depicts a second embodiment of the sole, taken along lines 6-6 in FIG. 5. In the FIG. 6B embodiment, the sole 12 includes an outsole 14, a lower sole 36 that is affixed to the outsole, and an upper sole 62. The volume between the lower sole 36 and the upper sole 32 is filled with ETBs 10, resulting in an ETB-filled footbed. The FIG. 6B embodiment is therefore similar to the FIG. 6A embodiment, except that the ETBs are not confined in a separate inner bag. As a result, the description of the FIG. 6A embodiment applies in large part to the FIG. 6B embodiment. However, the absence of the inner bag with buttonholes makes it more difficult to attach the straps directly to the lower sole assembly, so variations in which the straps are connected to the upper sole 62 are preferred for this embodiment.

[0029] FIG. 6C depicts a third embodiment of the sole, taken along lines 6-6 in FIG. 5. The FIG. 6C embodiment is similar to the FIG. 6B embodiment, except that the lower sole 36 serves as the outsole (in addition to performing its other functions). In this embodiment, the lower sole 36, taken alone, corresponds to the lower sole assembly 30 discussed above in connection with FIG. 3. Because only a single material is used, different trade offs between comfort and toughness may be required, as will be apparent to persons skilled in the relevant arts. In addition, appropriate changes to the way the upper sole 62 is connected to the lower sole assembly 30 may be required, as will be apparent to persons skilled in the relevant arts.

[0030] FIG. 6D depicts a fourth embodiment of the sole, taken along lines 6-6 in FIG. 5. The FIG. 6D embodiment is similar to the FIG. 6C embodiment, except that the lower sole

comprises two separate pieces of material: the sidewalls 32 and the outsole 14. In this embodiment, the sidewalls 32 and the outsole 14, taken together, correspond to the lower sole assembly 30 discussed above in connection with FIG. 3. Note that although it is not depicted in FIGS. 6C and 6D, an inner bag may be added to those embodiments to retain the ETBs, similar to the bag 40 (shown in FIGS. 4A-4C) described above in connection with the FIG. 6A embodiment.

[0031] Optionally, the straps may be stuffed with the same material that is used to fill the footbed (see reference numeral 10 in FIGS. 6A-6D), such as the preferred expanded polystyrene beads. FIG. 7 depicts a cross section of this type of strap, taken along section line 7-7 of FIG. 5. In the illustrated embodiment, a double-walled construction is used, and both walls 72, 74 are preferably flexible. Note that although FIG. 7 depicts a space between the inner wall 72 and the outer wall 74, in practice the walls will touch in many places. They are depicted separately, however, for explanatory purposes.

[0032] Similar materials to those described above in connection with the upper sole 62 may be used for the walls 72, 74. The inner wall 72 is hose-shaped, with the ends of the hose closed off to keep the filling 70 contained. Because a double-walled construction is used, the inner hose 72 need not be affixed directly to the sole. Instead the inner hose is contained within an outer hose 74, and the outer hose is affixed (e.g., sewn, glued, etc.) to the sole 12. Optionally, intermediate members may be used to connect the outer hose to the sole (e.g., a member with a plug at one end for connecting to the sole and an eyelet at the other end to accept the end of the outer hose). In alternative embodiments, a single-walled construction is used, in which case the single wall must be connected to the sole (either directly or through an intermediate member).



[0033] Prototypes of the sandals described above have proven to be extremely comfortable.

[0034] While the present invention has been explained in the context of the preferred embodiments described above, various changes may be made to those embodiments and various equivalents may be substituted without departing from the scope of the invention, as will be apparent to persons skilled in the relevant art. Examples of such changes include, but are not limited to, using the ETB filling (or substitutes therefor) in other styles of sandals (e.g., T-strap sandals, athletic sandals, etc.) or in other types of footwear (e.g., insoles and footwear with uppers such as shoes, sneakers, boots, etc.).